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Sandia National Laboratories, Albuquerque Environmental Baseline Update 1992

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Project Number 301182.56.01

May 1992

List of Abbreviations/Acronyms

2ZN	Air Monitoring Station at 6000 Anderson, SE
ABC/AQCB	Albuquerque/Bernalillo County Air Quality Control Board
ACRR	Annular Core Research Reactor
ACHP	Advisory Council on Historic Preservation
AHPA	Archeological and Historic Preservation Act
AIA	Albuquerque International Airport
AIRDOS-EPA	See Chapter 14, Glossary
AIRDOS-PC	See Chapter 14, Glossary
AIRFA	American Indian Religious Freedom Act
AL	Albuquerque
AQCR	Air Quality Control Regulations
ARC-Tunnel	Reentry Burn-Up Simulation
ARAR	applicable or relevant and appropriate requirement
ARPA	Archaeological Resources Protection Act
AT&T	American Telephone and Telegraph
BLM	U.S. Bureau of Land Management
CAA	Clean Air Act
CAS	Chemical Abstract Service
CCC	Civilian Conservation Corps
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CGI	Chambers Groups Inc.
COE	U.S. Army Corps of Engineers
CWL	chemical waste landfill
CX	categorical exclusion
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EAP	educational assistance program
ECL	Environmental Checklist
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FO	Field Office
FR	Federal Register
FY	Fiscal Year
HAP	hazardous air pollutant
HCF	Hot Cell Facility

List of Abbreviations/Acronyms (Continued)

HERMES-III	20 MeV Gamma Simulator (photonuclear reactions)
HMTA	Hazardous Materials Transportation Act
HRS	Hazard Ranking System
HSWA	Hazardous and Solid Waste Amendments of 1984
IT	International Technology Corporation
KAFB	Kirtland Air Force Base
KUMSC	Kirtland Underground Munitions Storage Center
LIHE	Light-Initiated High Explosives
LLW	low-level waste
LMO	Line Management Official
MESA	Mathematics, Engineering, and Science Achievement
MOA	Memorandum of Agreement
MSL	Melting and Solidification Laboratory
MTF	Memorandum to File
MWL	mixed waste landfill
NAA	Nonattainment area
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NGTF	Neutron Generator Test Facility
NHPA	National Historic Preservation Act
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NMHU	New Mexico Highlands University
NMSU	New Mexico State University
NRHP	National Register of Historic Places
NTU	nephelometric turbidity unit
OEL	occupational exposure limit
PBFA-II	Particle Beam Fusion Accelerator-II
PO	Program Office
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RQ	reportable quantity
SARA	Superfund Amendments and Reauthorization Act
SATURN	X-ray machine (pinch activation)
SCB	Semiconductor Bridge
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SNL	Sandia National Laboratories, Albuquerque
SPCC	Spill Prevention Control and Countermeasures
SPR	Sandia Pulsed Reactor

List of Abbreviations/Acronyms(Continued)

Units of Measure

C	Celsius
Ci	curie
dBA	A-weighted decibels
F	Fahrenheit
m	meter
μCi	microcurie
MJ	megajoule
mi	mile
pH	relative acidity
PM_{10}	particulate matter 10 microns or less in diameter
y	year
km	kilometer
km^2	square kilometer
mrem	millirem
Mev	mega electron volt
g	gram
mg	milligram
μg	microgram

Chemical Symbols and Compounds

α	Alpha particle
^{41}Ar	Argon
CO	Carbon monoxide
Cr	Chromium
^{129}I	Iodine
^{85}Kr	Krypton
^{13}N	Nitrogen
^{15}O	Oxygen
^{3}H	Hydrogen
SO_2	Sulfur dioxide
^{238}U	Uranium
^{133}Xe	Xenon
^{235}U	Uranium
NO_2	nitrogen dioxide
NO_x	nitrous oxide
PCB	Polychlorinated biphenyl
TCA	trichloroethane
TCE	trichloroethene
TOC	total organic carbon
TOX	total organic halogen

Preface

Section 102(2)(c) of the National Environmental Policy Act (NEPA) requires agencies to:

> (I)nclude in every recommendation or report on proposals for . . . major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on . . . the environmental impact of the proposed action. . . .

For this reason, the Council on Environmental Quality (CEQ) regulations contained in 40 CFR Parts 1500-1508 that implement NEPA focus almost exclusively on the preparation and review of environmental impact statements (EIS) and environmental assessments (EA).

The purpose of this Sandia National Laboratories, Albuquerque (SNL) Environmental Baseline Update is to provide the background information necessary for SNL personnel and contractors to prepare clear and concise NEPA documentation. Subsection 2.1 summarized the CEQ requirements for the format and contents of a NEPA document (40 CFR §1502). The scope of the Environmental Baseline Update is to provide comprehensive data needed to support a description of the affected environment at the SNL facility. The "description of the affected environment," required by the CEQ regulations in 40 CFR §1502.15, is an essential prerequisite for assessing the environmental consequences (§1502.16) of a proposed action (project) to be implemented by SNL.

It is intended that this Environmental Baseline Update be used as a source document for preparation of environmental descriptions in Action Description Memoranda (ADM), EAs, and EISs. Some of the descriptions may be longer than is required since the CEQ regulations specify the "descriptions shall be no longer than necessary to understand the effects of the alternatives" (§1502.15). Some of the environmental descriptions (e.g., noise and visual resources) will not be relevant to every proposed action.

The Environmental Baseline Update includes, as an appendix, a list of organizations that were Contacted in the preparation of this report. Sandia National Laboratories personnel or contractors may find the same list to be a useful reference during the preparation of future NEPA documentation. Normally, a section in a NEPA document is devoted to a list of persons or organizations/agencies contacted during the preparation of the document, as well as a list of preparers.

The narrative, tabular, and figure information provided in the Environmental Baseline Update can be used either as a "boilerplate" for further NEPA documentation or as a "springboard" for gathering more extensive project-specific data. A "baseline" is precisely as the term indicates: a summary of existing information that serves as a foundation on which to build needed documentation.

1.0 Background

1.1 Early History

Sandia Laboratory was established in 1945 and operated by the University of California until 1949, when President Truman asked American Telephone and Telegraph (AT&T) to assume the operation as an "opportunity to render an exceptional service in the national interest." (Furman, 1990) Designated by Congress as a national laboratory in 1979, Sandia National Laboratories (SNL) is one of the U.S. Department of Energy's most diverse laboratories and one of the nation's largest research and development facilities (Sandia Laboratories, 1980). Thirteen years later, AT&T continues to operate SNL for the U.S. Department of Energy on a no-profit, no-fee, no-cost basis. The Lab's main responsibility is national security programs in defense and energy, with primary emphasis on nuclear weapons research and development. Sandia also does work for the Department of Defense and other federal agencies on a noninterference basis.

1.2 SNL Today

Activities at SNL (Figure 1-1) include: process development, environmental testing, radiation research, combustion research, computing, and microelectronics research and production. Over SNL's four decades of existence, its mission has expanded from an original focus on nuclear weapons research and development to include research on other advanced military technology, energy programs, arms verification, control technology, and applied research in numerous scientific fields, including an extensive program in materials research. Energy efforts include combustions research, integrated geosciences research, solar, and wind power programs. SNL environmental projects include programs in waste reduction and research for environmentally conscious manufacturing. SNL is a leader in scientific computing, especially in massive parallel processing, and it has an extensive semiconductor research and development program. SNL is also working to strengthen the nations's economic security by transferring the commercially valuable technology developed at SNL to the United States industry. Today, industry produces several billion dollars worth of products made possible by SNL-developed technology.

List of Abbreviations/Acronyms (Continued)

TAT	Transcontinental Air Transport
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSP	total suspended particulate
TTR	Tonopah Test Range
TWA	Transcontinental and Western Air, Inc.
UNM	University of New Mexico
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VMS	Visual Management System
VOC	volatile organic compound
VQO	Visual Quality Objective

3.0 Geology

The geomorphology, stratigraphy, structural geology, seismicity, soils, paleontology, and hydrology of SNL is described in the following sections.

3.1 Geomorphology

SNL is situated in the eastern portion of the Albuquerque Basin (Figure 3-1). This basin is one of the largest of a series of north-trending basins (about 90 mi [100 km] long and 30 mi [50 km] wide) along the Rio Grande that lies within the northern portion of the Mexican Highlands section of the Basin and Range physiographic province (Fenneman, 1931). This basin is bounded by the Sandia and Manzano Mountains in the east, the Lucero uplift and Puerco plateau in the west, and the Nacimiento uplift in the north. The southern boundary is defined by the Socorro channel. The basin is widest in the Albuquerque area and is constricted to the south and north. Large-scale faulting, deepening of the basin, and tilting of the mountain areas occurred approximately 11.2 to 5.3 million years ago. Since then, basin deposits have been laid down in a complex sequence of sedimentary and volcanic rocks (ERDA, 1977) Landforms within the basin include mesas and structural benches, low hills and ridges, inset stream terraces, and graded alluvial slopes (Lozinsky et al., 1991; Kelly, 1977; Kelly and Northrup, 1975).

The majority of the Albuquerque Basin is composed of poorly consolidated sediments eroded from the surrounding mountain areas, following the faulting and structural changes that occurred 11.2 to 5.3 million years ago. Specifically, the upper part of the basin fill is comprised of a complex sequence of gravel, sand, silt, clay, and caliche deposits known as the Santa Fe Formation. Underlying these deposits are sedimentary rocks of unknown total thickness, although gravity and aeromagnetic mapping indicate that these rocks extend about 15,000 feet (4600 m) below ground level (ERDA, 1977). These sedimentary rocks overlie the Precambrian (590 million years ago) rocks that underlie the entire basin, and then lift up to form the western plateaus and eastern mountains. The Sandia Mountains are about 5000 feet (1500 m) above the basin, giving a total difference in elevation between bedrock in the basin and the mountains of about 20,000 feet (6000 m) (ERDA, 1977).

3.2 Stratigraphy

About 23 million years ago and continuing through the present, the Albuquerque Basin filled approximately 15,000 ft (4600 m) with sediments eroded from the surrounding mountains (Lozinsky et al., 1991). This sequence of sediments, the Santa Fe Group, thins toward the edges of the basin where it is truncated by uplifted fault blocks. Santa Fe Group sediments are overlain in places by

the 5.3- to 1.6-million-year-old Ortiz Gravel deposits and in places are interbedded with Rio Grande river deposits and volcanic deposits (Table 3-1) (Kelley 1977).

Table 3-1

Generalized Stratigraphy with Approximate Ages of Deposition

Million Years Ago	Unit	
0.01 - 0	Unnamed Alluvial and Eolian Sediments	
1.6 - 0.01	Ortiz Gravel	
5.3 - 1.6	Santa Fe Group	Ceja Member
		Middle Red Member
23.7 - 5.3		Zia Member

Source: Modified from Kelley, 1977.

The Santa Fe Group consists mainly of fan-shaped deposits eroded from the Manzanita, Sandia, and Manzano mountains. These fan--shaped deposits are composed of coarse, poorly to moderately sorted sediments ranging in size from clay to boulders and vary in thickness from inches (centimeters) to several feet (meters). These units pinch out or are disrupted by erosion and have limited continuity in map view. However, flood deposits can lay thin sheets of fine sediments over large areas.

The Ortiz Gravel was deposited after deposition and subsidence of the Santa Fe Group. Subsequent uplift caused the Ortiz to be extensively eroded, leaving a discontinuous gravel unit of 0 to 150 ft (0 to 46 m) in the area of SNL south of Tijeras Arroyo. Overlying the Ortiz Gravel in this area are recent fan-shaped deposits eroded from the eastern mountains that contain sediments from Tijeras Arroyo. The exact thickness of the Tijeras Arroyo sediments are unknown (Kelley, 1977). Recent work indicates that the Tijeras Arroyo sediments vary from 100 to 300 ft (30 to 90 m) near SNL (Goodrich, 1991).

3.3 Structural Geology

The Albuquerque Basin is flanked by normal faults to the east and west (Figure 3-1, mapview; Figure 3-2, cross-sectional view). These faults are exposed along the eastern margins of the mountains (Kelley, 1961; Kelley and Northrup, 1975; Kelley, 1977; and Machette, 1982). The north-trending Hubble Springs Fault runs parallel to the Manzano Fault along the east side of the basin. The northeast-trending Tijeras Fault is evidenced by a 31 mi (50 km) fault scarp from Manzano Base to Golden, New Mexico. These

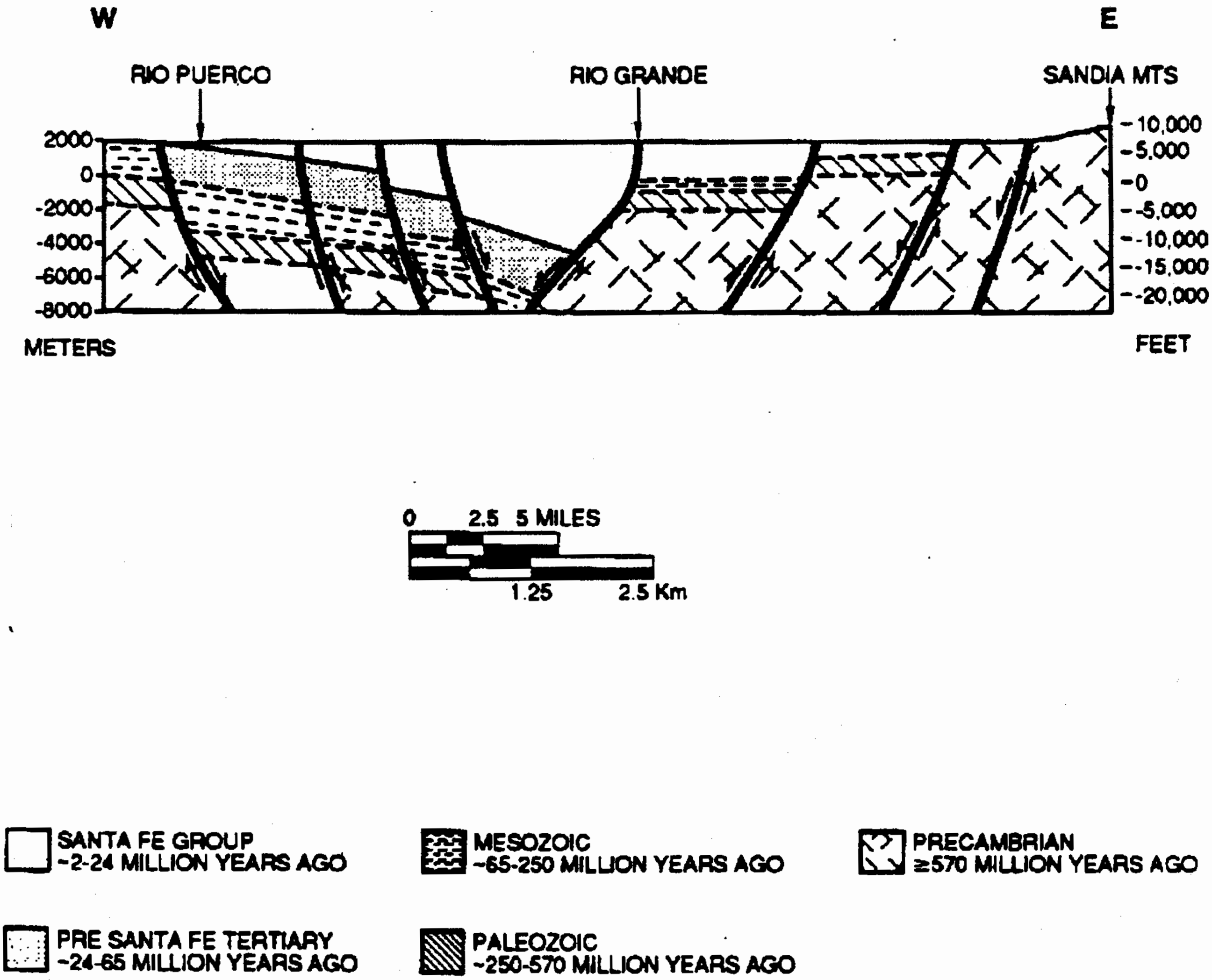


Figure 3-2
Generalized Geologic Cross-Section of the Albuquerque Basin
(Lozinsky et. al., 1991)

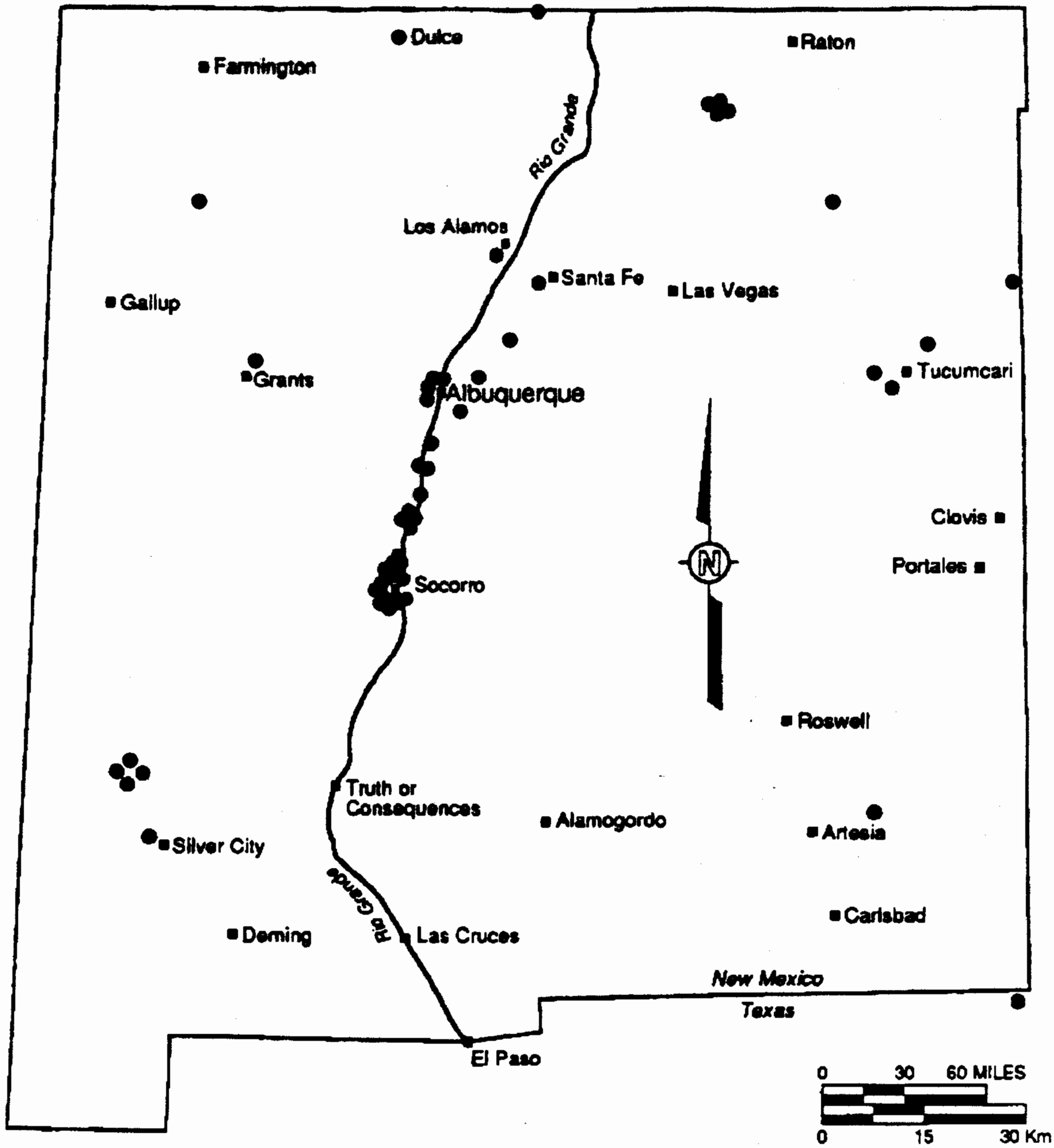
fault systems intersect in the SNL area where the subsurface structure is probably complex. The series of faults on the east side of the Sandia and Manzano Mountains have a vertical displacement of at least 20,000 ft (6000 m). The displacement occurred approximately 11.2 to 5.3 million years ago. There is no evidence that movement on these faults, with accompanying strong earthquakes, has occurred within geologically recent times (the past 10,000 years) (ERDA, 1977).

3.4 Seismicity

The Albuquerque area is located in Seismic Risk Zone 2 (ERDA, 1977), which, by definition, is a region that can be expected to receive moderate damage from earthquakes (corresponding to Intensity VII of the Modified Mercalli Intensity Scale of 1931). The scale measures the amount of ground shaking with respect to damage to cultural features. An example is Intensity VII: "Everybody runs outdoors, damage to buildings varies depending on quality of construction; noticed by drivers of automobiles." The records for this region show fairly high activity but low magnitude and intensity, especially compared to west coast earthquakes. There have been only ten earthquakes of Intensity VII in New Mexico in the last century (ERDA, 1977).

New Mexico earthquakes with a Mercalli Intensity of VII or greater, since records were first kept in 1869, are shown in Tables 3-2 and 3-3. However, the records are poor and incomplete, with 1869 being the earliest recorded date. Many of the earthquakes have occurred in sparsely populated regions, where there is little to no interest in keeping earthquake records. The earlier records (newspapers articles, diaries, and letters) are inadequate to determine the origin of the earthquakes. The earthquake locations, with a modified Richter magnitude of 3.5 or larger, are shown in Figure 3-3 (ERDA, 1977). It is likely that earthquakes have occurred in the Albuquerque Basin since the basin stabilized in its present form, approximately 11.2 to 5.3 million years ago (ERDA, 1977).

The earthquakes that have most affected New Mexico in the past century are those of 1906, 1966, and 1971. A series of shocks occurred at Socorro almost daily from July 2, 1906, until well into 1907. On July 12, 1906, some adobe walls were cracked and others thrown down. Wave-like ground motion was seen and there were fissures in the ground. A more severe shock on July 16, 1906, was felt at Raton, New Mexico, and Douglas, Arizona, each over 200 mi (300 km) distant from the origin and a train was nearly derailed 10 mi (16 km) west of Socorro. A November 15, 1906, shock at Socorro was felt over a region of about 100,000 mi^2 (260,000 km^2). The history of the Socorro region shows frequent earthquakes of some intensity.



■ Approximate locations of cities.

● Approximate locations of reported earthquakes, magnitude 3.5 or larger, since 1868.
Most of the locations are based on felt reports, so they are not very accurate.
The largest earthquake ocurred near Socorro in 1906. The magnitude was probably between 6 and 7. This earthquake was felt as far away as Raton, New Mexico.

Figure 3-3
Reported Earthquakes in New Mexico, Magnitude 3.5 or Larger, Since 1868

largest in New Mexico since 1906. Between January 23 and 28, 119 aftershocks were recorded at the Coast and Geodetic Survey's Albuquerque observatory 140 miles (220 km) to the south (Lander,1966).

Perhaps the strongest shock of the century in the Albuquerque area was that of January 4, 1971, even though it was only of magnitude 4.7. The county jail, University of New Mexico, and West Mesa High School reported cracked walls, window breakage, and damage from fallen items. The records indicate no appreciable or serious damage to SNL or Energy Research and Development Administration (ERDA) buildings; although cracks were observed in some buildings, there was no evidence that these cracks did not predate the earthquake. The cracks were noticed only after the event, when a search for possible damage was made.

As noted, the Albuquerque area has been classified as being located in Seismic Risk Zone 2, a zone subject to moderate seismic damage, which corresponds to Intensity VII of the Modified Mercalli Intensity Scale. Analysis of one thousand earthquakes revealed that most seismic activity falls into three areas: 1) The Socorro and Albuquerque; areas of the Rio Grande Rift, 2) the Mount Taylor area and 3) the Estancia Basin (Jaksha and Sanford, 1986). The evidence given above indicates that moderate damage is a reasonable expectation, if an earthquake occurs, but earthquakes are of rare incidence. The largest shock predicted in New Mexico in a 100-year period is of magnitude 6 (Sanford et al., 1972). All buildings used by SNL are built to the specifications of the Seismic Risk Zone, as specified in the Uniform Building Code (ERDA, 1977).

3.5 Soils

The Albuquerque Basin extends from the gently sloping area near the Rio Grande to the steeply sloping Manzano and Sandia Mountains. Well-drained loamy soils dominate, with minor amounts of gravelly and stony soils along the arroyos and on the mountains. General soils information is given in Table 3-4. The dominant soil for a geographic area is shown on Figure 3-4. Minor amounts, less than 30 percent, of other soils are present within each dominant map unit on Figure 3-4.

The Bluepoint Series consists of deep, somewhat excessively drained loamy fine sand on terraces. Elevations range from 4850 to 6000 ft (1480 to 1830 m) with 1 to 15 percent slopes. Bluepoint soils are associated with Kokan, Latene, Madurez, and Wink Soils (USDA, 1977).

The Embudo Series consists of deep, well-drained gravelly fine sandy loam that formed weathered granitic rocks on old fan-shaped deposits. Elevations range from 5000 to 6500 ft (1500 to 2000 m) with 0 to 5 percent slopes. Tijeras and Wink soils are associated with the Embudo Series (USDA, 1977).

The Gila Series consists of deep well-drained loamy soils that formed in and at the mouth of Tijeras Arroyo. Elevations range from 4850 to 6000 ft (1480 to 1830 m) with 0 to 2 percent slopes. Small areas of Embudo, Bluepoint, and Glendale soils are mapped with this unit (USDA, 1977).

The lldefonso Series consists of gravelly, sandy loam that is found in areas near Hell Canyon Wash and west of the Manzano Mountains. Elevations range from 6000 to 7000 ft (1830 to 2100 m) with 1 to 9 percent slopes. A small percent of Latene soils are mapped with this unit (USDA, 1977).

The Laporte Rock outcrop Escabosa Complex contains 35 percent Laporte loam with 20 percent rock outcrop and 15 percent Escabosa loam. The Laporte loam is a very shallow to shallow soil derived from weathered limestone from the mountain foothills. The rock outcrop is limestone while the Escabosa loam is a moderately deep, weathered soil that formed from the weathered limestone of the rock outcrop. The elevations range from 6500 to 7500 ft (2000 to 2300 m) with 5 to 20 percent slopes. Approximately 20 percent of lldefonso, Manzano, Silver, and Witt soils are included in this mapping unit (USDA, 1977).

The Latene Series consists of deep well-drained loamy to fine sandy soils. Elevations range from 5000 to 6000 ft (1500 to 1830 m) with 1 to 5 percent slopes. Wink and Madurez soils make up about 15 percent of the unit (USDA, 1977).

The Madurez Series consists of deep, well-drained fine sandy loam that formed on piedmonts in old unconsolidated alluvium modified by wind. Elevations range from 4900 to 5900 ft (1500 to 1800 m) with 1 to 5 percent slopes. Limited amounts of Bluepoint, Latene, and Wink soils are associated with the Madurez Series (USDA, 1977).

The Nickel-Latene association is approximately 50 percent gravelly fine sandy loam (Nickel) with 40 percent sandy loam (Latene). The remaining 10 percent is composed of rock outcrop. Elevations range from 5200 to 5800 ft (1600 to 1800 m) with 1 to 30 percent slopes. These soils are associated with Latene, Tome, and Wink soils (USDA, 1977).

The Pino-Rock outcrop association is about 40 percent silt loam. The Rock outcrop (30 percent) is limestone with minor amounts of sandstone outcrops. Elevations range from 7400 to 8000 ft (2300 to 2400 m) with 3 to 15 percent slopes. Escabosa and Laporte soils are included in this mapping unit (USDA, 1977).

Sandstone, limestone, or basalt exposed through faulting or stream channel erosion compose 90 percent of the Rock outcrop. Elevations range from 6000 to 10,000 ft (1800 to 3000 m) with 25 to 80 percent slopes. The remaining 10 percent of the unit is composed of gravelly, stony debris found at the base of the moderately to very steep slopes (USDA, 1977).

The Salas complex is composed of very gravelly loam with the remaining 30 percent stony soils. Elevations range from 6000 to 7000 ft (1800 to 2100 m) with 20 to 80 percent slopes. Laporte soils and Rock outcrop make up the remaining 15 percent of the mapping unit (USDA, 1977).

The Seis Series formed moderately deep, well-drained very cobbly loam, very stony clay loam, and very stony light clay loam composed of weathered limestone from the mountains. Elevations range from 6000 to 7800 ft (1800 to 2400 m) with 0 to 60 percent slopes. These soils are mapped with minor amounts of lldefonso and Silver soils (USDA, 1977).

Fifty-five percent of the Silver and Witt soils are deep, well-drained very fine sandy loam derived from sedimentary rocks and 25 percent is the very fine sandy loam of the Witt soils derived from mixed rocks. Silver soils are dominant south of Interstate 40 (I-40) and Witt soils dominate north of I-40. Elevations range from 6400 to 7500 ft (1950 to 2300 m) with 0 to 15 percent slopes. Manzano and Laporte soils are found within this mapping unit (USDA, 1977).

Tesajo-Millet is a stony sandy loam. Elevations range from 6000 to 7000 ft (1800 to 2100 m) with 3 to 20 percent slopes. Rock outcrop composes 20 percent of this unit where the surface is covered with boulders (USDA, 1977).

The Tijeras Series are yellowish-brown gravelly fine sandy loam. Elevations range from 5000 to 6500 ft (1500 to 2000 m) with 1 to 5 percent slopes. Embudo, Madurez, and Latene soils comprise 20 percent of this unit (USDA, 1977).

The Tome Series are very fine sandy and silt loam derived from limestone and shale. Elevations range from 4800 to 5600 ft (1500 to 1700 m) with slopes of 0 to 2 percent. Madurez and Wink soils make up 15 percent of this mappable unit (USDA, 1977).

The Wink Series consists of brown, well-drained, fine sandy and sandy loam. Elevations range from 5000 to 6000 ft (1500 to 1800 m) with slopes of 0 to 7 percent. Wink soils are associated with Madurez, Latene, Bluepoint, and Embudo soils (USDA, 1977).

Cut and fill land consists of sandy loam and very gravelly sand that has been mixed for residential, industrial, and business developments. It is on high terrace breaks of the Rio Grande Valley, primarily within Albuquerque. Elevations range from 4900 to 6000 ft (1500 to 1800 m) with 1 to 25 percent slopes. Minor pockets of Bluepoint, Kokan, and Wink soils are associated with cut and fill land (USDA, 1977).

3.6 Paleontology

Few fossils have been discovered in the vicinity of SNL. Lambert (1968) describes fossil vertebrate remains approximately 3 to 5 mi (5 to 8 km) west-northwest of Technical Area III (Figure 3-5). An ankle bone of the extinct Pleistocene camel *Camelops* (on the basis of size) was excavated from a lenticular deposit of silt and fine sand, interbedded with sandy gravel on the south side of Tijeras Arroyo. In the same area, two horse teeth identified as being from *Equus cf. plesippus* or *E. bautistensis* were found loose near the bottom of a small arroyo. The headwaters of the arroyo drain a lense 10 to 15 ft (3 to 4.5 m) thick of interbedded clay, silt, fine sand, and tuff. The teeth were found about 50 ft (15 m) downstream from the lense and undoubtedly weathered from it (Lambert, 1968). Near the mouth of Tijeras Arroyo, vertebrate fossils were collected in a quarry (locality outside of Figure 3-5). They included most of a horse skull identified as cf. *Equus* and hare teeth identified as cf. *Lepus*.

According to Lambert (1968), the formation containing the fossils consists of stream deposits, interbedded with sediments that were deposited on the basin floor and arroyo bottoms. The high-energy environments associated with the formation suggest that, although the formation may not extend beneath SNL, the fossils may have been transported varying distances from their original source. It is possible that fossils are present at SNL but are buried by the alluvial fan deposits from the Sandia Mountains.

3.7 Hydrology

The following sections describe the surface-water and ground--water hydrology of the SNL area and monitoring programs at SNL, KAFB, and vicinity.

3.7.1 Surface-Water Hydrology

The major surface hydrologic feature in central New Mexico is the Rio Grande, which flows north to south through Albuquerque and lies approximately 5 mi (8 km) west of KAFB (SNL, 1991a). Average flow in the Rio Grande from 1967 to 1977 was about 816,000 acre ft/yr (1.01 x 10^9 m^3/yr) (COE, 1979a). The East Mesa, on which SNL is located (SNL, 1992), has a generally west-southwestward ground surface slope, ranging from about 250 ft/mi(47 m/km) near the mountains to 20 ft/mi (3.8 m/km) near the Rio Grande. The distance from the foot of the mountains to the river varies from 3 mi (4.8 km) in the northern part of the mesa to 9 mi (10 km) in the southern part. There are minor surface water bodies, as wetlands, on the East Mesa (SNL, 1992). See Section 5.0 for a description of canyon wetlands, including Coyote Springs and Sol se Mete Spring.

Surface water on East Mesa is in the form of sheet flow that drains into small gullies during precipitation events. The water is carried by natural and artificial flow paths into the two

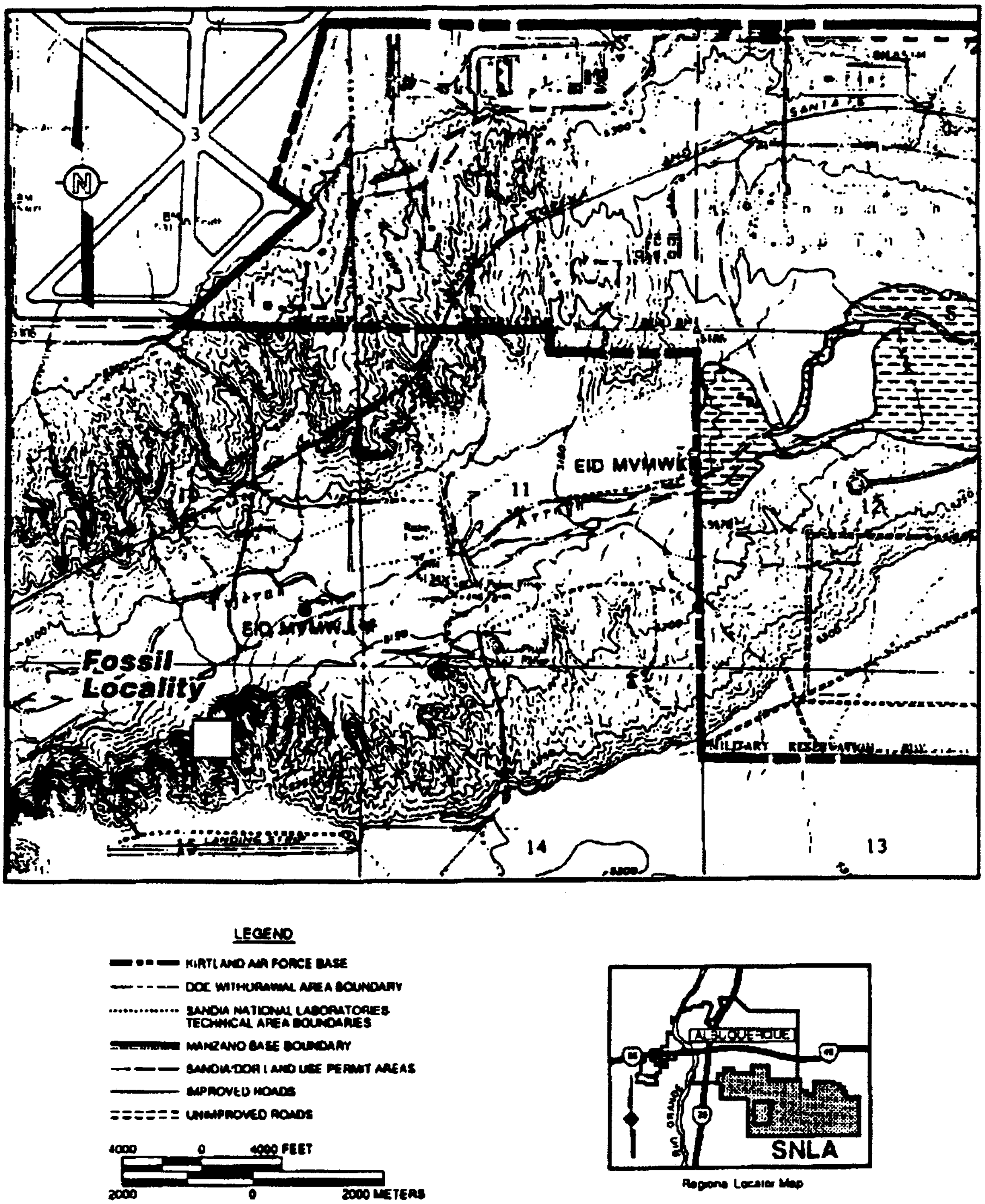


Figure 3-5
Fossil Locality, Sandia National Laboratories, Albuquerque, New Mexico

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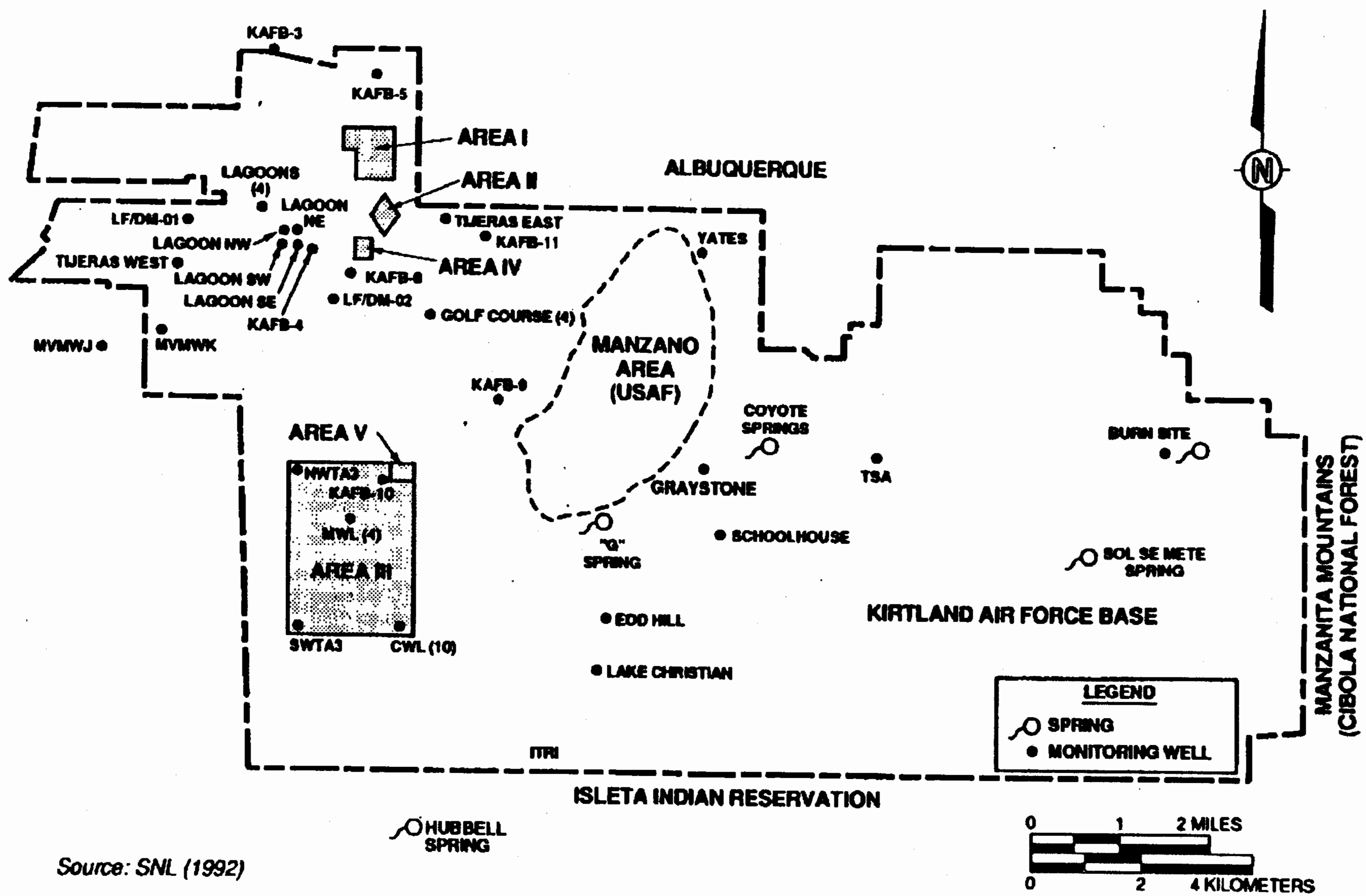


Source: SNL (1992)

Figure 3-7

SNL and KAFB Monitoring Wells & Springs
Sandia National Laboratories

3.7.1.3 USGS Surface-Water Stations

The USGS has measured surface-water discharges at nine gauging sites in Tijeras Arroyo and Arroyo del Coyote (Borland, 1991). Water quality assessments have not been conducted at these sites. Data available for various periods are shown in Table 3-5.

Table 3-5
Surface Water Monitoring Stations

Site	Period of Record	WATSTORE No.[a]
1. Tijeras Arroyo at Albuquerque Crest stages only	1943-1949 1958-1990	08330500
2. Tijeras Arroyo at Albuquerque (Above Four Hills Bridge)[b]	1989-1991	08330505
3. Tijeras Arroyo at KAFB[b]	1987-1988	08330560
4. Tijeras Arroyo at Montessa Park[c]	1987-1991	08330580
5. Tijeras Arroyo near Albuquerque[c] Crest stages only	1974-1991 1951-1968	08330600
6. Tijeras Arroyo (Below Arroyo Del Coyote)	1989-1991	08330569
7. Tijeras Arroyo (Below South Diversion)[b]	1980-1988	08330800
8. South Diversion Channel (Above Tijeras Arroyo)[c]	1988-1991	08330775
9. Arroyo del Coyote at KAFB	1989-1991	08330565
10. Arroyo del Coyote (Above Tijeras Arroyo)	1989-1991	08330567

[a] The National WATer-Data STOrage and REtrieval System (WATSTORE) is operated and maintained by the USGS at its national center in Reston, Virginia. Address inquires to:
Chief Hydrologist
U.S. Geological Survey MS 437
National Center
Reston, Virginia 22092

[b] Gauging station is not currently operational.

[c] Discharge data for water, 10/89 to 9/90, are published in: Borland, J. P., R. R. Cruz, R. L. McCracken, R. L. Lepp, D. Ortiz, and D. A. Shaull, 1991, "Water Resources Data New Mexico Water Year 1990," NM-90-1, U.S. Geological Survey Water-Data Report.

3.7.2 Ground-Water Hydrology

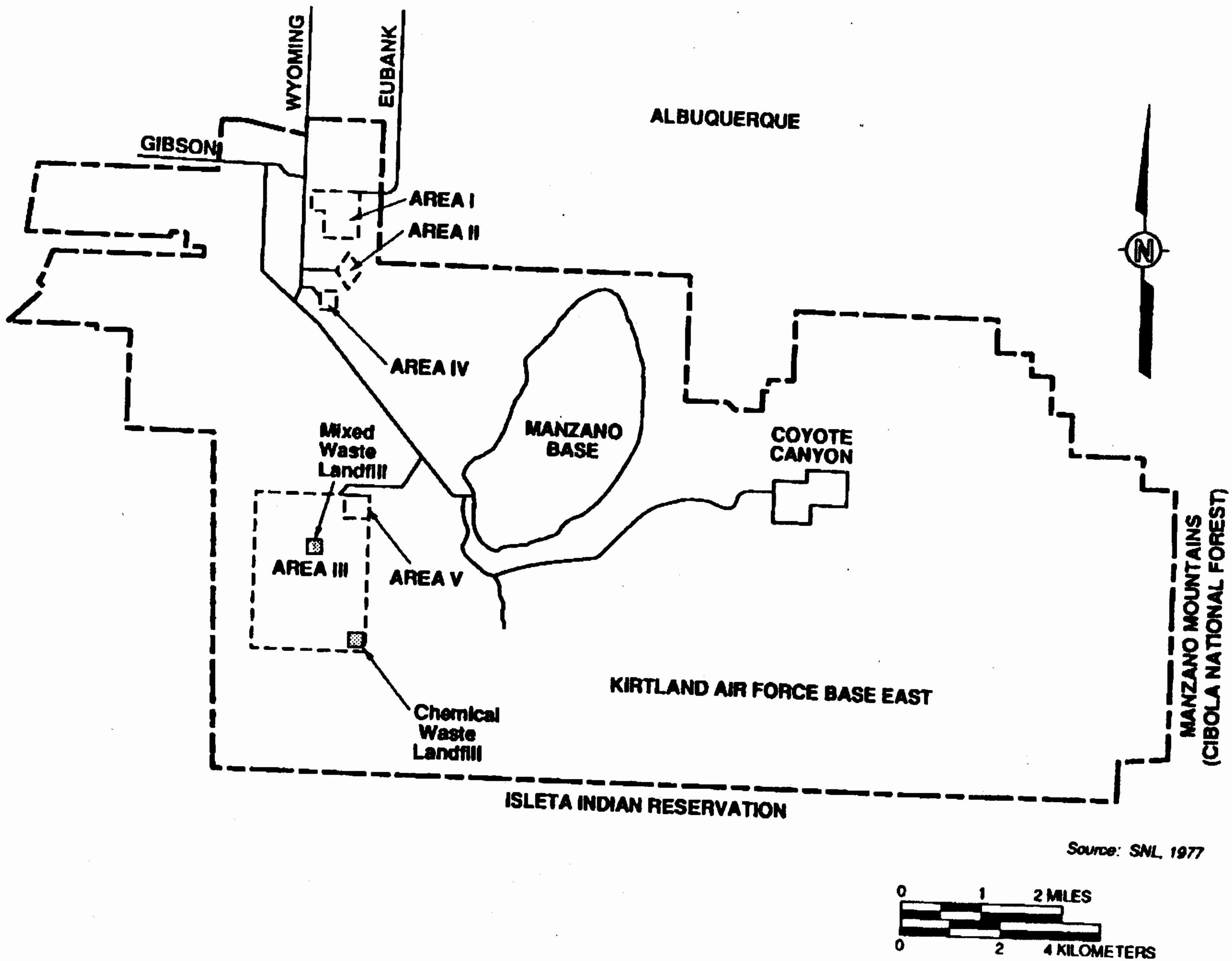
The same large, unconfined aquifer that occupies the Albuquerque Basin is present under SNL. The faults described in Section 3.3 separate the regional water table into a somewhat deep region west of the fault complex and a much shallower region on the east side. The depth to saturated ground water underlying SNL facilities varies from 50 to 100 ft (15 to 30 m) east of the faults and from 377 to 492 ft (115 to 150 m) west of the faults (SNL, 1991a). Most SNL facilities are located west of the fault system in the area of deeper ground water. At KAFB and vicinity, the capacity of the aquifer to transmit ground water is estimated at about 0.16 ft^2/s (0.015 m^2/s) (SAIC, 1985).

The subsurface reservoir is recharged primarily from the Rio Grande and, to a lesser degree, at the foot of the mountains through coarse alluvium at the openings of small canyons (Kues, 1986). Recharge is nearly nonexistent from percolation through soils overlying the water table. Moisture in the form of rain or snowmelt flows into small channels that feed Tijeras Arroyo and the Rio Grande, evaporates, or is transpired by the local vegetation. The significance of Tijeras Arroyo as a source of recharge to the shallow ground-water zone remains undetermined (Kues, 1986).

3.7.2.1 Ground-Water Monitoring Well Network

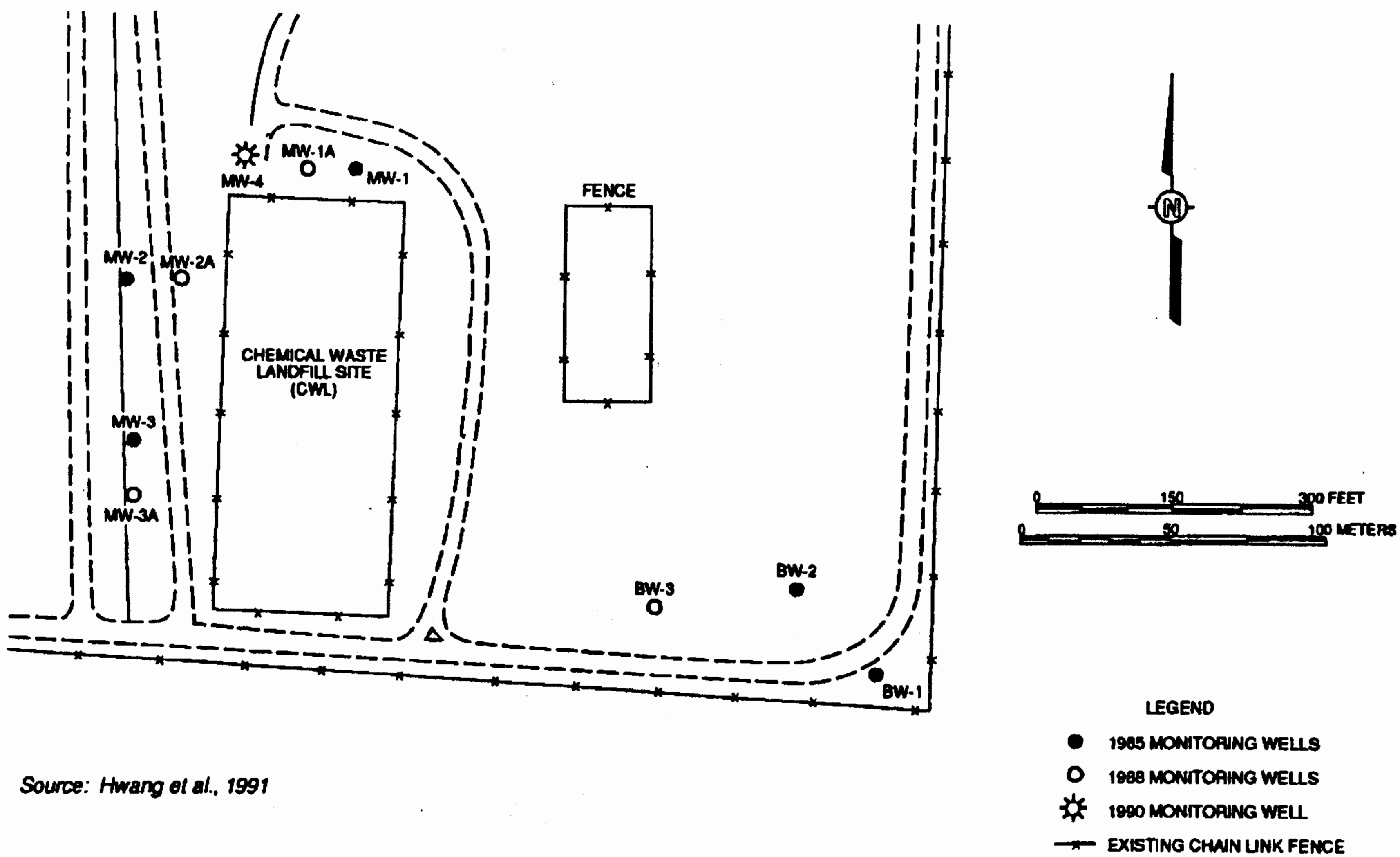
Prior to 1990, 11 ground-water monitoring wells were being monitored for water levels monthly. These wells included nine wells at the chemical waste landfill (CWL), one well at the mixed waste landfill (MWL), and well KAFB-10 (Technical Area III). The locations of the MWL and CWL are shown on Figure 3-8. In December 1990, SNL began monitoring 12 additional wells belonging to KAFB: four in Tijeras Arroyo, four at the KAFB golf course, and four at the KAFB sanitary lagoons. These wells, along with the six new monitoring wells SNL expects to have installed by the end of 1992, will bring the total to at least 42 wells by the end of 1992. A complete description of the physical characteristics of the wells (e.g., total depth, screened interval, casing material, filter pack material, geographic coordinates, etc.) is reported in SNL (1992).

The ground-water monitoring program at the CWL has been operational since 1985. The monitoring well system at the CWL consists of a network of nine wells (Figure 3-9). Five of the wells (MW-1, MW-2, MW-3, BW-1, and BW-2) were installed at the CWL in 1985. These wells were completed at various vertical depths within the aquifer, with screened intervals ranging from 70 to 460 ft (20 to 140 m) in length. By June 1990, five additional wells (BW-3, MW-1A, MW-2A, MW-3A, and MW-4) were installed at the CWL. They have 20-ft (6-m) screened intervals located such that about 15 ft (4.6 m) of screen is below the water table. In July 1988, MW-1 became plugged by a bailer and has not been monitored since.



Source: SNL, 1977

Figure 3-8
Location of the CWL and MWL at Sandia National Laboratories, Albuquerque



Source: Hwang et al., 1991

Figure 3-9
Locations of Monitoring Wells at the CWL

A monitoring well network was established at the MWL in 1988, when MW-1 was installed. Three additional wells (MW-2, MW-3, and BW-1) were installed between June and September 1989 (Figure 3-10). These wells have 20-ft (6-m) screened intervals located from 5 ft (2 m) above the water table to 15 ft (4.6 m) below the water table.

3.7.2.2 Ground-Water Quality Monitoring

Background conditions of the ground water quality at the CWL were determined for all of the current monitoring wells. Background values of the 40 CFR §265, Appendix III, drinking water supply parameters, contamination indicator parameters, and ground-water quality parameters were collected quarterly for a period of one year (December 1988 to January 1990). Each quarter, four replicate samples were collected for the indicator parameters (pH, specific conductance, total organic carbon [TOC], and total organic halogen [TOX]), and the initial background arithmetic mean and variance were determined by pooling the replicate measurements for the respective parameter concentrations or values in samples obtained from the upgradient well as required by 40 CFR §265.92(c)(2) (SNL, 1992).

In 1990, background conditions of the ground-water quality at the CWL were determined for all of the current monitoring wells regulated under RCRA (SNL, in preparation).

A quarterly background ground-water quality assessment for the CWL monitoring wells BW-3, MW-1A, MW-2A, MW-3A, and MW-4 took place in May, August, and November, 1991 (SNL, in preparation). The results are presented in SNL (1992).

After establishing background conditions by sampling for indicator parameters on a quarterly basis for a year, the sampling interval was changed from quarterly to semiannually for ground-water contamination indicator sampling and annually for ground--water quality sampling.

The first semiannual contamination indicator sampling at the CWL was performed in March 1990. Ground-water monitoring parameters (40 CFR Part 264, Appendix IX) were also measured in anticipation of closure requirements (IT, 1990b). A change from detection monitoring to assessment monitoring was required following the discovery of trichloroethene contamination in well MW-2A.

The indicator parameter statistical results from the March semiannual sampling are provided in Hwang et al. (1991), and statistical results from the May 1990 resampling are provided in IT, (1990a and 1990c). The results of assessment monitoring in May, August, and December 1990 are also presented in Hwang et al. (1991). Details of the August and December 1990 sampling events may be found in IT (1991a and 1991b) and SNL (1991a).

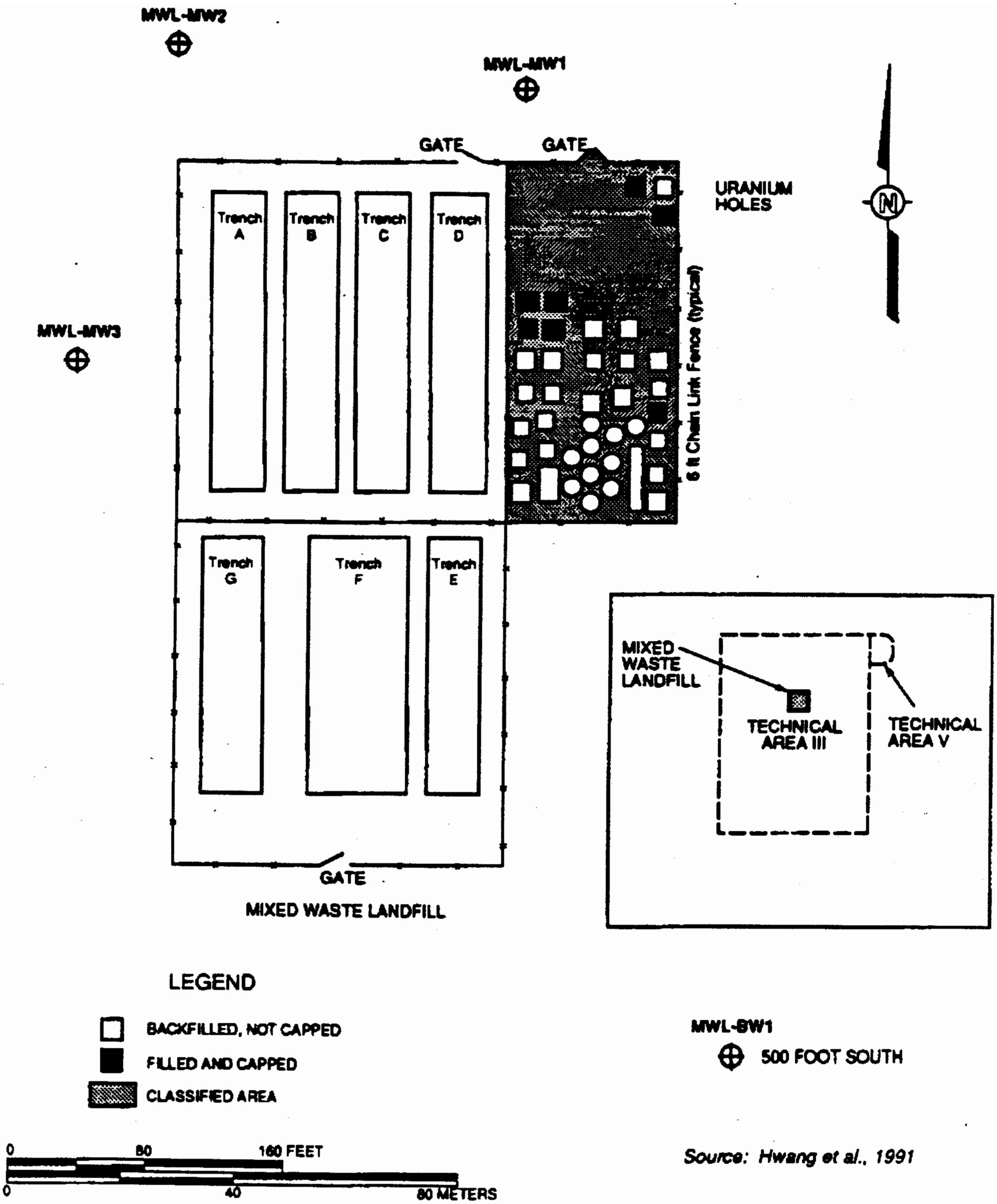


Figure 3-10
Locations of Monitoring Wells at the MWL

Quarterly sampling for background ground-water quality monitoring at the MWL was performed in January, April, July, and October 1991. These sampling events were conducted in accordance with the draft "Mixed Waste Landfill Ground-Water Sampling and Analysis Plan" (SNL, 1990b). Background monitoring parameters include Appendix III drinking-water supply parameters (metals, pesticides, herbicides, nitrate, coliform bacteria, alpha activity, beta activity, and radium), ground-water quality parameters (Cl, Fe, Mn, Na, sulfate, and phenols) and ground-water contamination parameters (pH, SC, TOX, and TOC). Analyses for metals included both a filtered fraction (<0.45 μ) for dissolved metals and an unfiltered fraction for total metals. Additional radioisotope baseline data are being collected and will be documented in a future report for information purposes (SNL, 1992).

Quarterly reports summarizing the results of the January and April sampling events have been submitted in draft status (IT, 1991d, 1991e). Reports for the July and October events will be submitted when complete analytical results have been received (i.e., for radionuclide fractions). Summaries of values for assessment parameters for all four quarters are included in SNL (1992).

SNL also initiated a large-scale ground-water sampling and analysis program in 1991 (SNL, 1992). That effort was initiated with a program to sample monitoring wells across SNL and KAFB for background hydrogeochemical parameters. The objective of the program was to determine if regional trends in ground-water chemistry exist and if such trends are related to geologic structures or geographic location. The background hydrogeochemical data from the study will also provide the Environmental Restoration Program with KAFB-regional data that may be relevant to estimations of potential contaminant transport rates from hazardous waste sites. Samples were collected from 16 wells and four natural springs on KAFB and Isleta Pueblo in April, July, and October; another series of samples were collected in January 1992. All samples were analyzed for Mg, Ca, K, Na, Fe, F, Cl, Br, NO_3, NO_4, alkalinity, pH, and temperature; results are listed in SNL (1992). Figure 3-7 shows all the sampling sites. KAFB pumping wells are not included in this sampling program.

3.7.2.3 USGS Monitoring Program

The USGS has also installed wells to monitor ground-water contamination, under the U.S. Air Force Installation Restoration Program (Wilcox, 1991). Ten sites administered by the USAF at and near KAFB are being investigated. Initial characterization of the sites in 1989 included analysis of more than 100 soil samples and full RCRA Appendix IX analysis of water samples from the wells. (The ten wells are distributed among three of the study sites.) Quarterly sampling and analysis, begun in August 1990, have been of indicators found during initial characterization (Wilcox, 1991): TOC, TOX, nitrates, and total dissolved chromium. The soil and water data, quarterly sampling data, and results of the first semiannual sampling (completed in late 1991) will be in a draft report to be submitted by the USGS to the USAF in early 1992, entitled "Installation Restoration Program Phase II-Stage 2 Remedial Investigation," prepared for the U.S. Air Force Center for Environmental Excellence/Environmental Restoration Division, Brooks Air Force Base, Texas.

The USGS is also installing ground-water monitoring wells at the seven sites that do not currently have wells. This program will be Phase IIA of the Installation Restoration Program; no data have been collected as of this writing.

3.7.2.4 Physical Characteristics of Ground Water

The apparent direction of ground-water flow west of the fault complex, is generally to the west and northwest (SNL, in preparation). Ground water has been reported to generally move from north to south in the shallow zone (above 4800 ft or 1500 m), while deep-zone ground water (below 4800 ft or 1500 m) moves from the northwest to the east and southeast (Kues, 1986). The direction of ground-water flow reported by Bjorklund and Maxwell (1961) is southwesterly. These differences are attributed to the influence of KAFB and nearby Albuquerque production wells (SNL, in preparation).

The complex geology and data from the monitoring wells are insufficient to characterize the hydrology east of the fault system (SNL, 1991a). The direction of ground-water flow would typically be out of the canyons and westward toward the fault system. The installation of six wells is planned for 1992, specifically to help determine the effect of the fault system on regional ground-water flow.

Albuquerque obtains all of its drinking water from ground water. Economic growth in the past 30 years and consequent increased pumping from KAFB and the city's deep municipal supply wells have significantly altered the saturated ground-water flow direction in the vicinity of SNL (SNL, 1991a). The KAFB and nearby Albuquerque production wells greatly affect the ground water level in the SNL area creating a lower ground-water surface elevation in the northern region. Over 1.6 billion gallons of water are pumped from the KAFB production wells annually (SNL, in preparation). It is possible that the KAFB production well pumping is the cause of water-level fluctuations observed in some of the SNL and KAFB monitoring wells. Pumping rates at KAFB production wells and hydrographs of water levels in all SNL and KAFB monitoring wells are reported in SNL (1992). By the year 2000, the regional water table will have dropped an additional 30 to 50 ft (9 to 15 m) because of continued domestic and industrial use (Reeder, 1967). The most recent estimate of pumpage in the Albuquerque area has

Table 4-4

Wind Speed and Prevailing Wind Direction for Albuquerque, New Mexico - Ending 1990

	(a)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
WIND:														
Mean Speed (mph)	51	8.1	8.9	10.1	11.0	10.6	10.0	9.1	8.3	8.6	8.3	7.9	7.7	9.0
Prevailing Direction through 1963		N	N	SE	S	S	S	SE	SE	SE	SE	N	N	SE
Fastest Obs. 1 Min.														
- Direction (II)	6	09	09	28	17	28	08	36	27	25	09	27	09	09
- Speed (mph)	6	52	40	41	46	46	40	52	41	40	32	48	47	52
- Year		1990	1989	1986	1985	1986	1990	1990	1990	1985	1986	1988	1987	Jan 1990
Peak Gust														
- Direction (II)	7	E	W	NW	E	S	E	N	E	W	NW	W	E	N
- Speed (mph)	7	70	63	66	64	61	67	72	63	61	51	63	71	72
- Date		1990	1984	1986	1990	1987	1986	1990	1989	1985	1986	1988	1987	Jul 1990

(a) Length of record in years, although months may be missing. Wind direction numerals show tens of degrees clockwise from true north. Resultant directions are given to whole degrees. The data were collected at the Albuquerque International Airport, Latitude: 35° 03'N Longitude: 106° 37'W Elevation: 5,311 ft (1,619 m).

Notes: To convert mph to kph, multiply by 1.6 km/mi.

Unless otherwise indicated, dimensional units used in this table are: wind movement in miles per hour.

Figures instead of letters in a direction column indicate direction in tens of degrees from true north, i.e., 09-east; 19-south; 27-west; 36-north, and 00-calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "fastest mile" the corresponding speeds are the fastest observed 1-minute values.

II = to 8 compass points only.

Reference: National Oceanographic and Atmospheric Administration (NOAA), 1990, "Local Climatological Data, Annual Summary with Comparative Data," Albuquerque, New Mexico.

4.2 Precipitation

The valley and mesa areas are arid, having an average annual precipitation near 8 in. (20 cm). The average annual precipitation in the mountains is considerably heavier, with 20 in. (5 1 cm) (SNL, 1989). Precipitation amounts generally increase with increasing elevation. Half of the average annual precipitation occurs in the form of brief but heavy thunderstorms during the summer period, July through September. Moisture is supplied by the general southeasterly circulation of moist air over the Gulf of Mexico from the Bermuda high-pressure area which shifts westward in summer. Strong surface heating combined with the air movement over higher terrain causes convective air currents and condensation. The average number of days per year having 0.10 in. (0.30 cm) or more precipitation for the Albuquerque area is 61 and the average number of days per year having 1 or more in. (> 3 cm) of snow or ice pellets is 4 (NOAA,1990). Evapotranspiration in the area has been estimated at 95 percent of the annual rainfall (Thomson and Smith, 1985).

The winter months, November through March, are generally very dry, with normally less than 2 in. (5 cm) of moisture (NOAA, 1990). Winter precipitation is caused by moisture associated with Pacific Ocean storms moving west to east across the country. Much of the moisture from these storms precipitates over the mountains west of New Mexico as the storms move eastward. Snow rarely remains on the ground in the valley for more than 24 hours. However, snow cover in the mountains is common from mid-November to early spring. The average annual snowfall for the Albuquerque area is 14.7 in. (27.3 cm) (NOAA, 1990).

4.3 Wind

The average annual wind speed for the Albuquerque area is 9 mi/hr (4 m/s). Sustained winds of 12 mph (5.3 m/sec) or less occur approximately 80 percent of the time at the Albuquerque International Airport, while sustained winds greater than 25 mph (11 m/s) have a frequency less than 3 percent (NOAA, 1990). Winds blow most frequently from the north in winter and from the south along the river valley in summer. Winds are generally stronger in the late winter and early spring months, and occasionally dusty days occur due to blowing soils. At SNL, winds are almost equally probable from all directions, under normal conditions, with speeds generally less than 8 mi/hr (3.5 m/sec). The wind speeds reach 30 mi/hr (13 m/s) less than 48 days each year (DOE, 1987).

The proximity of SNL to the Rio Grande Valley and the Sandia/-Manzano/Manzanita Mountains causes enhanced variabilities in weather conditions (particularly precipitation and winds) over the area cov 1 d b SNL t' y$ d

A network of seven meteorological towers surrounding SNL-operated nuclear reactors was established in July 1960 to monitor weather conditions; an eighth station was added in May 1965. The locations of these stations are described in Table 4-5. These studies indicate that the prevailing winds at SNL are from the east, except that winter winds at the 100-ft. (30-m) elevation are from the north. Rapid night-time ground cooling after sunset on cloudless or near cloudless nights produce strong temperature inversions (an atmospheric condition reversal of the normal temperature lapse rate in which temperature increases with increasing elevation). This rapid cooling effect generates drainage winds (katabatic winds) out of the mountains, which are strongest at the mouths of the larger canyons. It also appears that Tijeras Arroyo diverts surface air flow between Technical Areas III, V, and Coyote Test Field on the one hand, and Technical Areas I, II, IV, and Albuquerque on the other.

Specific wind information can be inferred from these studies, in particular Station One, which is located on the eastern boundary

Table 4-5
Meteorological Tower Locations
for Wind Study

Station Number	Location
One	Eastern Boundary of Technical Area III, 4 mi (6 km) south of Technical Area I
Two	6 mi (10 km) Southwest of Technical Area I at the mouth of Tijeras Arroyo, near Broadway SE
Three	4 mi (6 km) southwest of Technical Area I on Old Police Prison Farm, in Tijeras Arroyo
Four	Technical Area I, east of Building No. 880
Five	7 mi (10 km) east northeast of Technical Area I in Tijeras Canyon near Seven Springs
Six	9 mi (14 km) west northwest of Technical Area I in the valley at Old Town School
Seven	2 mi (3 km) west of Technical Area I near the east end of the east-west runway at the Albuquerque Sunport KAFB
Eight	6 mi (10 km) south of Technical Area I in Coyote Test Field's Thunderwell Area

Source: Olsen et al., 1970

of Technical Area III, and Station Four, which is located in Technical Area I east of Building 880. The channeling of wind through Tijeras Canyon can be seen by comparing the wind roses from these two areas. Figure 4-1, showing wind roses which summarize ten years of data from Stations One and Four (percent frequency at 100 ft [30 m]), were taken from the Environmental Monitoring Program (IT, in preparation).

In 1957, a pair of smoke tests were conducted in Technical Area III to measure local air trajectories. The tests were conducted when southeast winds combined with a strong inversion condition (considered the worst case scenario relative to a possible reactor incident). The results showed that the flow of smoke was predominantly downslope and northerly toward Tijeras Arroyo. The arroyo effectively blocked the northerly drift beyond the arroyo and redirected to flow in a westerly direction, down canyon in one case and in both directions (westerly and easterly) along the arroyo in the other case. The clouds did not pass the arroyo until the inversion had disappeared.

4.4 Severe Weather

The average number of thunderstorm days per year in the Albuquerque area is 41, the majority of which occur during the rainy summer period (NOAA, 1990). Often thunderstorms develop during the afternoon over the Sandia and Manzano Mountains and drift to the northwest over the Rio Grande Valley. The average number of days per year with fog (visibility less than 0.25 mi [0.4 km]) is only six (NOAA, 1990).

Tornadoes are virtually nonexistent in the Albuquerque area. Small tornadoes were observed in 1985 and 1987. Damage was very light and no official wind readings were noted. Based on climatological records, Albuquerque is classified as a region of low--tornado occurrence, with an annual frequency of 0.1 or less (DOE, 1990).

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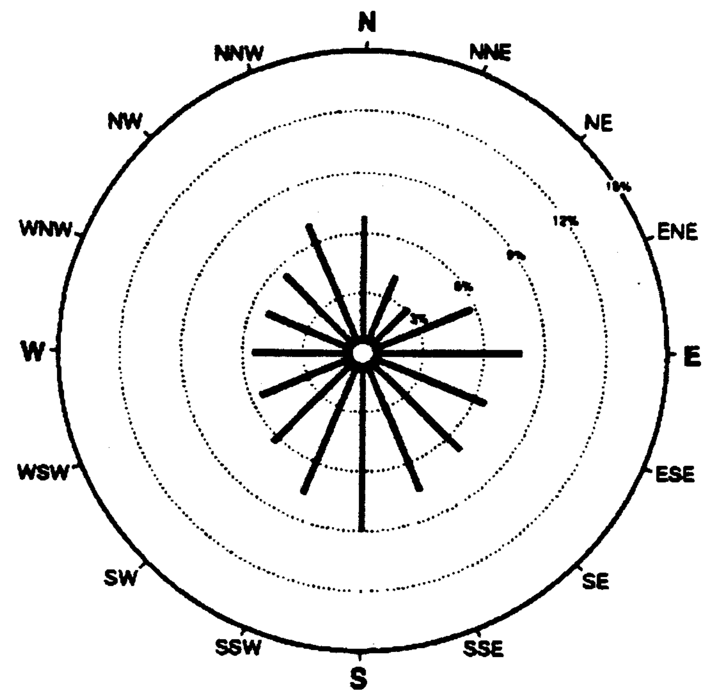
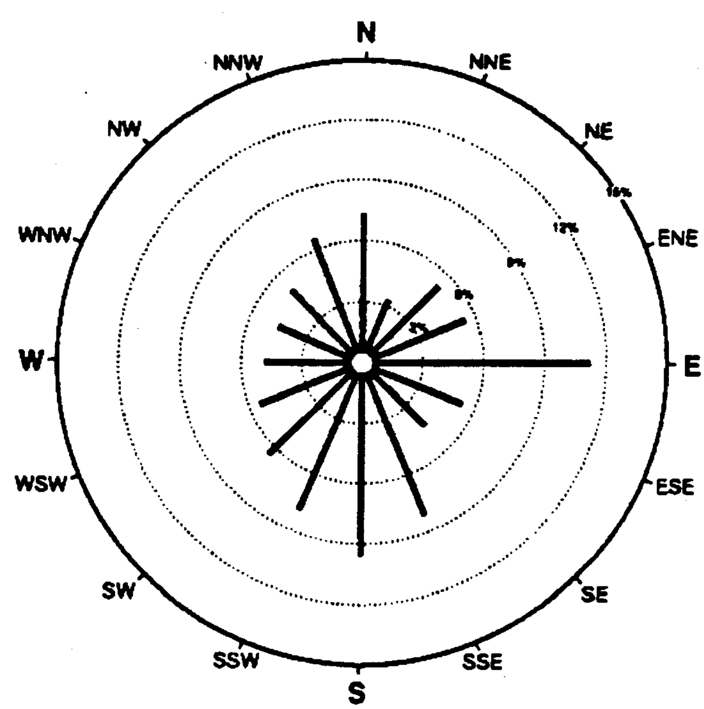


TECHNICAL AREA III



TECHNICAL AREA I

Figure 4-1
Average Annual Wind Direction
Sandia National Laboratories, Albuquerque (1960-1970)
(Wind Rose Frequency in Percent Time)

6.0 Air Quality

Ambient air quality is regulated by the Albuquerque/Bernalillo County Air Quality Control Board (ABC/AQCB). The ABC/AQCB also monitors compliance with federal and state air quality regulations. The Air Pollution Control Division under the Albuquerque City Environmental Health Department has set up several ambient air sampling stations throughout the city, including the area two miles (3 km) northwest of SNL, to monitor total suspended particulates (TSP), ozone, particulate matter (PM_{10}), carbon monoxide (CO), and nitrous oxide (NO_x).

SNL has conducted a preliminary inventory of the 189 Hazardous Air Pollutants listed in the Clean Air Act Amendments of 1990. The inventory shows that SNL has used 107 of the 189 chemicals listed. Only 30 chemicals are used in quantities exceeding 100 lb/yr, and only 12 of these are used in quantities exceeding 1,000 lb/yr (Table 6-1). SNL has over 1,000 emission sources

Table 6-1
Hazardous Air Pollutants with a Usage Inventory Greater than 1,000 Pounds

Chemical Name	Usage Inventory (in pounds)
Hydrochloric Acid	140,838
Sulfuric Acid	16,504
Hydrogen Fluoride	6,032
Nitric Acid	5,601
Methyl Chloroform	5,281
Ethylene Glycol	4,940
Freon-113/CFS	4,667
Acetone	4,638
Isopropyl Alcohol	2,740
Toluene	2,482
Xylene	2,126
Methanol	2,028
Nickel/Nickel Compounds	1,311

(hood/vent) and over 300 individual emissions points (or stacks) (SNL, 1991g). A preliminary list of emission sources and the chemicals released are found in Appendix A. It would be an immense undertaking to investigate every single emission source and point for the 107 chemicals used. Therefore, SNL is conferring with the city to determine whether the scope of the inventory can be reduced after a preliminary review. The review would determine which chemicals, based upon their maximum potential emissions, require further investigation for individual usage and emission point parameters.

6.1 Radionuclide Airborne Effluents

A number of small releases of radioactive material from various sources occur at SNL. Facility releases occur from stack exhausts, for which the AIRDOS-EPA code calculates a momentum-type plume rise (Moore et al., 1979). The plume rise is calculated from the stack diameter and the exhaust velocity. Thermally hot exhausts, which can lead to much higher plume rises, are not present at any of the individual SNL facilities considered in this study. Emissions from the Particle Beam Fusion Accelerator-II (PBFA-II) were not included, because the contributions from this source are small compared to that of the 20 MeV Gamma Simulation (HERMES-III). Inhalation of airborne radionuclides is the most significant radiological human exposure pathway from SNL operations.

The radiation sources are in Technical Area II, Technical Area III, Technical Area IV, Technical Area V, and some small sources in Technical Area I. The radioactive emissions include ^{41}Ar ^{85}Kr ^{133}Xe, ^{3}H ^{13}N, ^{15}O, ^{129}I, ^{238}U, depleted uranium, and other gaseous activation and gaseous fission products. SNL submits annual radionuclide emission reports to the DOE under the requirements of DOE Order 5400.1 (DOE, 1988a) and the National Emission Standards for Hazardous Air Pollutants (NESHAPS). The Environmental Protection Agency issues NESHAPS permits for new sources and modifications to sources that result in 0.1 mrem/yr or greater dose to off-site members of the public. The dose criterion is based upon a potential maximum annual facility release, rather than the dose resulting from actual operations. SNL will report radionuclide air emissions in accordance with the NESHAPS reporting requirements promulgated under 40 CFR Part 61 , Subpart H.

6.2 Radiological Airborne Emissions

Of the number of releases of radiological material from various sources at SNL, only a few are significant sources of contaminated airborne emissions. Because most of SNL's air emissions are small and cannot readily be measured, the release data are calculated based on theoretical parameters such as reactor operating power (MJ/yr) and the conversion factor for steam plant, emergency diesel generator plant, portable generators used at remote testing sites , and the foundry release NO_x, CO, and SO_2.

Building 869, a Toxic Materials Machine Shop, occasionally conducts machining of beryllium-containing materials. The operation is regulated by the AQCR 31 standard for beryllium. The shop uses HEPA filters to control emissions, with a removal efficiency of more than 99 percent. Emissions tests conducted during December 1989 demonstrated that the actual beryllium emissions of less than 1.8×10^{-7} lb/yr (8.2×10^{-8} kg/yr) is less than the AQCR 31 limits of 9.2×10^{-4} lb/yr (4.2×10^{-4} kg/yr) specified in 40 CFR § 61.32 (SNL, 1991c).

The Microelectric Development Laboratory uses hydrochloric acid as a reagent for regeneration of ion-exchange columns for the deionized-water treatment system. Hydrofluoric acid is used as part of the etching solution in the process of microelectric parts. Both process events use scrubber systems to control emissions, with removal efficiency of 95 percent.

An incinerator for the disposal of classified combustible waste is located at the east end of Technical Area I but is not being used.

6.3.2 Technical Area III

Potential sources of nonradioactive air emissions include the Melting and Solidification Facility (MSL), Radiant Heat Testing Facility, Reentry Burn-up Simulation (ARC-Tunnel), Rocket Sled Track, and Thermal Treatment Facility (TTF). Potential airborne emissions for these facilities are discussed below in more detail.

Nickel, chromium, cobalt, and (to a lesser extent) manganese are used for metal-alloy production in the MSL facility. The material is heated in a closed vacuum induction melting system. Small amounts of vapor can escape the system only when the chamber is opened or if there is a leak in the system. Even if this were to occur, the release vapor would condense immediately on any surface with a temperature lower than the vapor temperature.

The air pollution emissions from the Radiant Heat Testing Facility during test periods consist mainly of smoke and fumes from the burning of small quantities of rubber, plastics, paint, etc. Smoke and fumes from the boiler combustion process and nitric acid emitted during test runs comprise the air pollution emissions from the ARC-tunnel. In addition to the air pollutants, the steam ejectors produce high-noise levels.

The potential hazards associated with the operation of the Rocket Sled Track are shrapnel, overpressurization, missile hazards from controlled or uncontrolled test units, toxic discharges, and fire. During 1990, there were a total of three NIKE rocket motor tests that released 3.73 lb of lead per test at the sled track area (SNL, 1990c).

The Thermal Treatment Facility is primarily used to treat silver acetylide-silver nitrate (SASN) contaminated waste from the light-initiated high-explosives (LIHE) facility. No waste other than that produced at the LIHE facility is treated at the TTF. The major byproducts of the thermal treatment of SASN and associated wastes are gases and particulates. The gases are primarily CO_2, CO, and NO_x. The particulates consist mainly of carbon (from burning paper, cloth, and other contaminated items) and elemental silver (from destruction of SASN).

6.3.3 Remote Testing Areas

Many facilities at SNL conduct explosives testing. This includes the Thermal Test and Analysis Division at Coyote and Lurance Canyon Burn Sites and various shock tubes. These testing areas are located south and east of Technical Area III and in the canyons on the west side of the Manzano Mountains. Potential airborne emissions from these facilities are discussed below.

The Coyote Test Field provides an area close to SNL for fielding large experiments, usually involving the detonation of large quantities of chemical explosives.

The Lurance Canyon Test Site is a remote facility for conducting experiments involving up to a maximum of 10,500 lb (4,760 kg) of explosives per shot, with a 2.5 mi (4 km) fragment-hazard radius.

Explosively driven shock tubes ranging in size from 4 in. (10 cm) to 19 ft (5.8 m) in diameter and lengths of 20 (6 m) to 300 ft (90 m) are used to subject various test items to blast environments.

The Thermal Test and Analysis Division at Coyote and Lurance Canyon Burn Sites and the TTF in Technical Area III conducted several burn tests during 1989. Open-burn permits are obtained from the city prior to each scheduled burn test according to the requirements of AQCR 3 (Open Burning).

6.4 Air Dispersion Models

Generally, monitoring of ambient air quality at SNL has not been conducted. However, a program that inventories individual emissions of specific chemicals from identified sources has been done and the data used to evaluate the impact of emissions on local ambient air. The emissions inventory was limited to sources of chemicals specified by SNL as they related to the SARA Title III, Section 313, and as listed in 40 CFR §§61.01(a) and (b), excluding radionuclides.

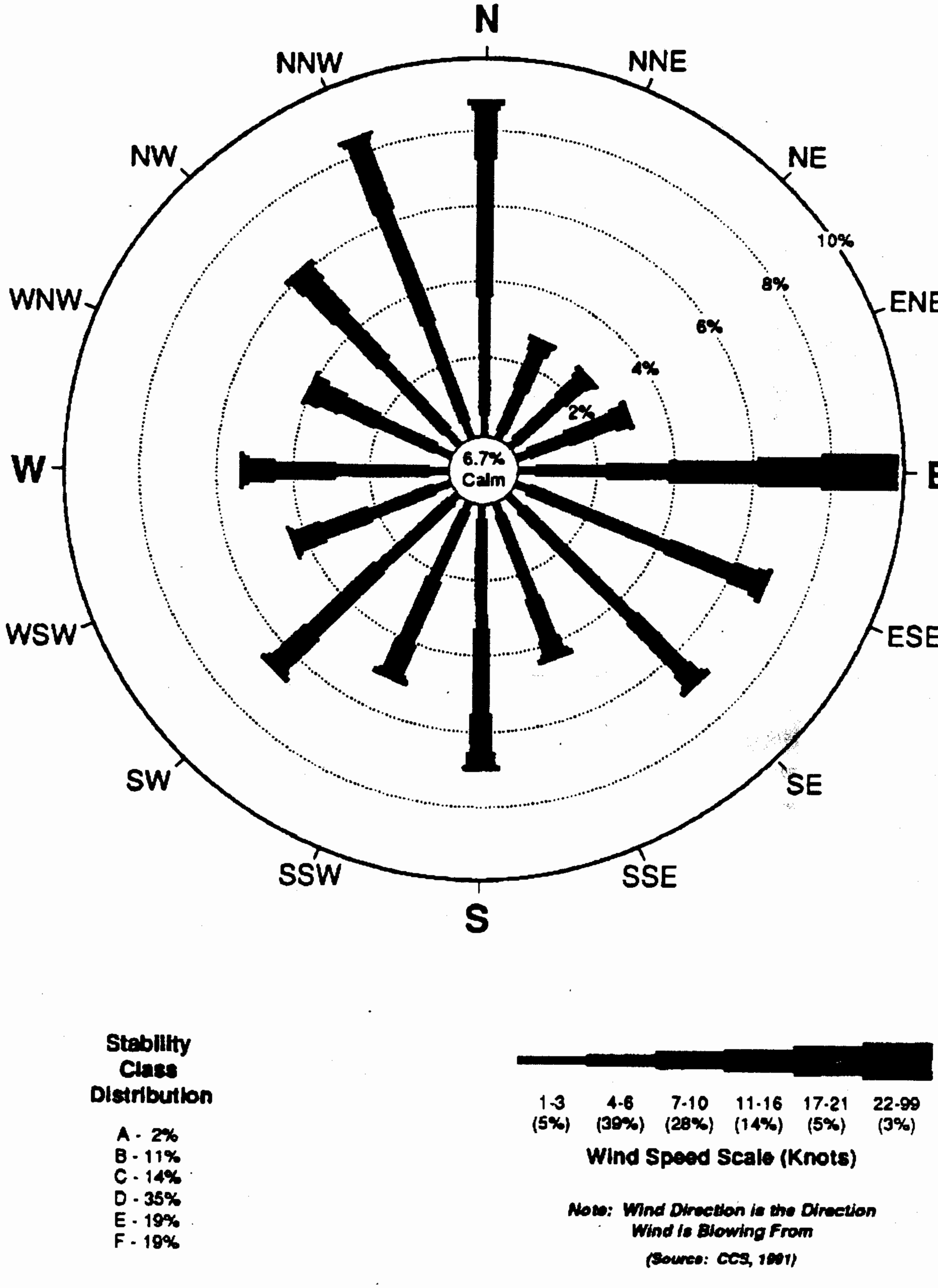


Figure 6-3
Wind Rose for 1987 Meteorological Data

- Heavy industrial
- Light to moderate industrial
- Commercial
- Compact residential.

The land in and around Technical Area I did not meet this requirement; therefore, the rural option was selected for modeling purposes.

6.5 Summary of Modeling Results

The impact on the ambient air of each chemical inventoried was calculated or estimated using the air dispersion model. The impact was estimated at each of the 477 receptor points located along the Technical Area I fence and outside the area at a distance of 0.6 mi (1 km) from a point inside Technical Area I, located at E359.000, N879.500 (Figure 6-2). This point represents the center of the grid with receptor points 0.6 mi (1 km) away from the point. The location was selected after considering the meteorological data used in the modeling effort. Air dispersion models indicated that 0.6 mi (1 km) was sufficient to locate the maximum impact points. No receptors located within Technical Area I were considered.

The most useful product from the model output is the estimated maximum 8-hour average concentrations calculated for each chemical and the location(s) where they were calculated to occur (Table 6-3).

The estimated maximum concentrations can be, and were, compared to established air quality standards such as the New Mexico Ambient Air Quality Standards and the 1 percent OEL. The calculated maximum concentrations, the coordinates of the receptor point, and the related air quality values are included in Table 6- 1 of the final report.

Analyses of modeling data were used to determine the compliance of any particular SNL source with the New Mexico air standards. Compliance with standards is performed on an individual source basis. That is, each individual source of an individual chemical must be considered by itself for compliance with the applicable standard. The model output was based on considering all of the sources in Technical Area I for each chemical in the inventory as contributing to the impact. Thus, the total impact for a given chemical from all sources does not exceed air quality standards.

When comparing the calculated maximum 8-hour concentrations model to the New Mexico standards, the air quality standards were referenced or adjusted to an elevation of 5500 ft (1700 m). The model results indicate that all of the ambient impacts of the emissions of all of the chemicals in the inventory are in compliance with the New Mexico standards.

6.6 Air Quality in the Southeast (SE) Heights

Atmospheric dispersion is a function of wind speed, duration and direction of wind, atmospheric stability, and mixing depth. Dispersion conditions are generally good if winds are moderate to strong, the atmosphere is of neutral or unstable stratification, and there is a deep mixing layer. Less favorable dispersion conditions may occur when the wind speed is light and the mixing layer is shallow. These conditions are most common during the late fall and winter when moderately to extremely stable atmospheric stratification exists.

Less favorable conditions also occur periodically for surface and low-level releases in all seasons from about sunset to about an hour after sunrise as a result of ground-based temperature inversions and shallow mixing layers. Occasionally there are extended periods of poor dispersion conditions that are associated with stagnant air in stationary high-pressure systems that occur primarily during the winter months. This stagnation is intensified by the mountain-valley geomorphology, with the Rio Grande valley to the west and the Manzano Mountains to the east.

Currently, Albuquerque has a citywide air monitoring program with station 2ZN as the closest monitoring station. The station is located approximately 2 mi (3 km) northwest of Technical Area I. Air monitoring data collected by the city from 1988 through 1990 were evaluated for PM_{10} and CO in the SE heights. The results indicated that SNL does not have an impact on the air quality [illegible]

7.0 Noise

This section provides an overview of SNL noise sources and conditions. However, except for noise baseline data collected for the Albuquerque International Airport (AIA), existing information is very limited. Comprehensive noise monitoring has not been conducted for SNL.

In order to present baseline noise conditions at SNL, it is important to define the terminology used in noise studies. This will assist the lay reader in understanding the subject of noise and refamiliarize the technical reader with certain terms. Refer to the Glossary, Section 14.0, for the definition of noise terms.

7.1 Overview of Noise Sources

Familiar noises are recorded as decibels (Table 7- 1). Noise sources in the vicinity of SNL can be categorized into two major groups: transportation and stationary type sources. Transportation sources are associated with moving vehicles that result in fluctuating noise levels above the ambient noise level for a short period of time. Transportation sources include aircraft, motor vehicles, and rail operations. An exception to this definition is a busy highway, which heard from a distance, results in a nonfluctuating transportation noise source. This type of source would sound like a constant low hum from such a distance. Stationary noise sources are those that either do not move or move relatively short distances. Noise-level fluctuations from stationary sources result from operational characteristics and other factors. Stationary noise sources in the vicinity of SNL include items such as ventilation systems, air compressors, generators, power transformers, and earth-moving equipment.

The most pervasive type of noise found at SNL is that of aircraft operations. AIA is located due west of SNL. The major runways (east/west) are adjacent to and point directly at SNL property. In addition, KAFB is located on the same property as SNL and utilizes AIA runways for its operations. Operational commercial and military aircraft dominate all other noise sources that influence noise levels at SNL, both in loudness and in percent contribution to above-average sound levels. Overall, a daily average of 1,005 daytime and 53 nighttime civil and military flight operations occur at the field. Military aircraft contribute 503 operations during the day and 13 operations at night, the term operation refers to either one departure or one approach (USAF, 1990). Although aircraft noise is the dominant source type, it is also a periodic source, with maximum noise levels associated with take-off and landing operations. Take-off and landing flight paths vary according to meteorological conditions and air traffic volume through AIA. Also, the type of aircraft

that use AIA influence the noise environment at SNL (i.e., small commercial planes versus jet aircraft).

Motor vehicle (highway) noise is also prevalent at SNL. On-site traffic as well as traffic on nearby roadways and major highways contribute to the overall noise levels at SNL. The fluctuation of highway noise (over long periods of time) is associated with the time of day in which peak and off-peak traffic occurs. In addition, noise levels are influenced by vehicle type, road-surface conditions (wet or dry), and exhaust systems.

The least prevalent transportation noise source is that produced by rail operations. No major commuter or freight rail lines or yards are located near SNL that could affect sound levels throughout SNL property. Freight lines that are present on SNL property may elevate noise levels for short periods of time on some portions of the facility.

Stationary noise sources that may influence the noise levels at SNL include but are not limited to ventilation systems, air intake for electrical generating stations, and mechanical and construction equipment. These types of sources, when operated individually, produce noise levels with characteristics that can be predicted or measured. When these sources operate simultaneously, the noise environment becomes very complex, and it is difficult to predict or measure the noise levels from individual sources. Stationary noise sources, grouped together for easy measurement and prediction, may be compared to ambient noise levels.

Construction and industrial type stationary sources, found throughout the SNL property, are concentrated mostly near the different technical areas. These types of sources contribute to the overall noise levels at SNL.

7.2 Existing Noise Data

This section describes the studies from which noise data were obtained and how the data characterize the baseline noise levels at SNL. Monitoring studies have contributed to the determination of baseline noise conditions. A description of the study is presented below.

Noise monitoring studies have been conducted on both SNL property and surrounding areas. Two surveys are presented that provide an estimated approximation of the sound level ranges experienced at SNL. It should be emphasized that the results of these monitoring studies represent the particular conditions on those days during which monitoring took place and that longer term studies are required in order to verify the existing monitoring data. The two monitoring studies used for this baseline report are as follows:

- The preliminary noise monitoring program conducted for AIA's noise compatibility study in areas surrounding the airport.

- A noise monitoring study to establish background/aircraft and Technical Area II operational noise in areas east of Technical Area II. A brief description of the studies and their results follow.

A noise monitoring program was conducted by Greiner, Inc. (1990) as part of a 1982 airport noise compatibility study. The monitoring program was designed, according to Federal Aviation Administration guidelines, to provide both 24-hour noise exposure data and selected individual fly-over noise data at various sites surrounding the airport. The measurements obtained during the study were applicable to the specific time period monitored. They do not necessarily reflect the average conditions presented at the individual monitoring sites over a long period of time.

Six monitoring locations were chosen for 24-hour measurements: the residential area west of the airport near Rio Grande High School; Veteran Administration Hospital; KAFB guardhouse off Eubank Boulevard near the SNL complex and Kirtland Building 20686; Four Hills Mobile Home Park; a residential area in Northeast Heights; and the Four Hills Country Club section. Other sites, typically for short-duration overflight studies, were identified and monitored when conditions existed for aircraft operations in those areas. Simultaneous monitoring was conducted at the various sites during each 24-hour monitoring period using two Bolt, Beranek, and Newman Model 614 portable sound-level meters. The meters recorded ambient sound levels on the A-weighted scale. They also produced hourly summaries, sound-exposure levels, and maximum-noise levels (Greiner, Inc., 1990). A summary of the data is presented in Table 7-2.

A second monitoring program was conducted by IT during the fall of 1990 to establish background and aircraft noise levels and current Technical Area II operational noise levels in areas east of Technical Area II. The monitoring program's measurements were obtained on a continuous (real-time) basis in the following center band frequencies: 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hertz. Two monitoring locations simultaneously recorded sound level data in the aforementioned frequencies from 7 a.m. to 6 p.m. for five days. The two monitoring locations were near the mobile home park approximately 1 mile (2 km) east of SNL and adjacent to Technical Area II, approximately 1,540 ft (469 m) east of Building 907. The sound level measurements were collected and recorded with Bruel and Kjaer (B&K) Model 2143 Real Time Frequency Analyzers, B&K Model 2639 Pre-Amp and Cable Interfaces, and B&K Model 4165, 1/2 in. (1 cm) Free Field Microphones (IT, 1990e). A summary of the data is presented in Table 7-3.

Table 7-2

Noise Level Ranges and Day/Night Averages as Measured in Areas Adjacent to the North and East Sections of SNL During 1982

Area	Maximum Hourly Noise Level Ranges (dBA)	Ldn (dBA)
Site C (KAFB Guardhouse at Eubank Blvd. Entrance)	82-95	68
Site D (Four Hills Mobile Home Park on Ram SE)	76-93[1]	62
Site F (Lamppost Circle in the Four Hills Country Club Area)	64-86	59
Site G (KAFB at Building 20686 North of Runway 8-26)	90-102[1]	75

[1]These maximum hourly noise levels coincide with peak airport operational hours.

Source: Greiner, 1990